# Bangalore Electricity Supply Company Limited

**TECHNICAL SPECIFICATIONS FOR PRESTRESSED CEMENT CONCRETE POLES (9Mtr PSCC Pole with working Load of 300Kg)**

**SCOPE:**

1.1 This Specification covers the manufacture as per designs, testing and supply of 9Mtr Long Pre-stressed Cement Concrete Poles (PSCC) - 300 Kg Working Load.

The poles shall be manufactured according to REC Standard with Working Load of 300Kg. (designed, tested, and approved by the cement Research Institute of India) the details of which are furnished in the drawings enclosed.

**2.0 APPLICABLE STANDARDS**

2.1 Except when they conflict with specific requirement in this specification, the poles shall comply with the relevant provisions made in the latest version of the following Indian Standards specifications:

a) IS 1678/1998 Specification for pre-stressed concrete poles for overhead power, traction and telecommunication lines.

b) IS 2905/1989 Methods of tests for concrete poles for overhead power and telecommunication lines.

c) IS 7321/1974 Code of practice for selection, handling and erection of concrete poles for overhead power and telecommunication lines.

**3.0 MATERIALS**

3.1 Cement: The cement used in the manufacture of pre-stressed concrete poles shall be any one of the following 53-grade ordinary Portland cement conforming to IS 12269.

a) Portland slag cement conforming to IS 455 but with not more than 50 percent slag content.

b) Rapid hardening Portland cement conforming to IS 8041.

c) 43 grade ordinary Portland cement conforming to IS 8112, and

d) 53 grade ordinary Portland cement conforming to IS 12269.

3.2 **Aggregates:** Aggregates used for manufacture of pre-stressed concrete poles shall conform to IS: 383 (Specification for coarse and fine aggregates from natural sources for concrete). The nominal maximum size of aggregates shall in no case exceed 12 mm.

3.3 **Water:** Water shall be free from chlorides, Sulphate, other salts and organic matter. Potable water will be generally suitable.

3.4 **Admixtures:** Admixtures should not contain chlorides in any form are likely to promote corrosion of pre-stressing steel. Admixtures shall conform to IS: 9103 (Specification for admixtures for concrete).

3.5 **Pre-stressing steel:** The pre-stressing steel wires, including those used as untensioned wires, should conform to any one of the following:

1. IS 1785 (Part-I) Specification for plain hard-drawn steel wire for pre-stressed concrete. Part-I-Cold drawn stress relieved wire,
2. IS: 1785 (Part-II) Specification for plain hard drawn steel wire for pre-stressed concrete, Part-II. As drawn wire, or
3. IS 6003 Specification for indented wire for pre-stressed concrete,
4. Uncoated stress relieved strand conforming to IS 6006 or IS 14268
5. High tensile steel bar conforming to IS 2090

The type designs given are for plain wires of 4 mm. dia. with guaranteed ultimate strength of 175 Kg / $mm^2$. All pre-stressing steel shall be free from splits, harmful stretches, surface flaws, rough, aged and imperfect edges and other defects likely to impair its use in Pre-stressed concrete.

## 4.0 CONCRETE MIX:

4.1 The concrete mix shall be designed to the requirement laid down for controlled concrete (also called design mix concrete) in IS:1343 Code of practice for pre-stressed concrete and IS:456 Code of practice for plain and reinforced concrete, Subject to the following special conditions:

a) Minimum works cube strength at 28 days should be at least 420 Kg./$Cm^2$.

b) The concrete strength at transfer shall not be less than half the 28 days strength ensured in the design, i.e., 420x0.5 = 210 Kg/$Cm^2$.

d) The mix should contain atleast 360 Kgs. of cement per cubic meter of concrete.

e) The mix should contain low water content as is consistent with adequate workability. If it becomes necessary to add water to increase the workability the cement content also should be raised in such a way that the original value of water cement ratio is maintained.

## 5.0 DESIGN REQUIREMENTS:

The poles shall be designed for the following requirements:

a) The poles shall be planted directly in the ground with a planting depth as indicated in drawing i.e., 1.7 M. for 9 M. poles
b) The poles should be suitable to take up a load of 300 Kg. applied at 0.6 M. from top.
c) The factor of safety for all these poles shall not be less than 2.0.
d) The average permanent load shall be 40% of the working load.
e) The FOS against first crack load shall be 1.0.
f) In the design value of first crack load the modulus of rupture shall not exceed 55.2 Kg sq.cm for M-40 concrete.
g) At average permanent load, permissible tensile stress in concrete shall be 30 Kg/Cm$^2$.
h) The ultimate moment capacity in the longitudinal direction should be at least one fourth of that in the transverse direction.
i) The maximum compressive stress in concrete at the time of transfer of pre-stress should not exceed 0.8 times the cube strength.
j) The concrete strength at transfer shall not be less than half the 28 days strength ensured in the design, i.e., 420x0.5 = 210 Kg/Cm$^2$.
k) The Poles shall be manufactured as per the enclosed drawings.

## 6.0 DIMENSIONS AND REINFORCEMENTS:

6.1 The cross sectional dimensions and the details of pre-stressing wire should conform to the particulars as per drawings.

6.2 The provisions of holes for fixing cross arms and other fixtures should conform to the construction practice adopted by BESCOM.

## 7.0 MANUFACTURE:

7.1 All pre-stressing wires and reinforcements shall be accurately fixed as shown in the drawings and maintained in position during manufacture. The un-tensioned reinforcement, as indicated in the drawings, should be held in position by the use of stirrups, which should go round all the wires.

7.2 All wires shall be accurately stretched with uniform pre-stress in each wire. Each wire or group of wires shall be anchored positively during casting. Care shall be taken to see that the anchorage does not yield before the concrete attains the necessary strength.

7.3 Cover: The cover of concrete measured from the outside of the pre-stressing tendon shall be normally 20 mm.

7.4 Welding & lapping of steel: The high tensile steel wire shall be continuous over the entire length of the tendon. Welding shall not be allowed in any case. However, jointing or coupling may be permitted provided the strength of the joint or coupling is not less than the strength of each individual wire.

7.5 Compacting: Concrete shall be compacted by spinning, vibrating shocking or other suitable mechanical means. Hand compaction shall not be permitted.

7.6 Curing: The concrete shall be covered with a layer of sacking, canvas, hessian or similar absorbent material and kept constantly wet up to the time when the strength of concrete is at least equal to the minimum strength of concrete at transfer of pre-stress. Thereafter, the pole may be removed from the mould and watered at intervals to prevent surface cracking of the unit, the interval should depend on the atmospheric humidity and temperature.

7.7 The pre-stressing wires shall be de-tensioned only after the concrete has attained the specified strength at transfer (i.e., 210 Kg/Cm$^2$). The cubes cast for the purpose of determining the strength at transfer should be cured, as far as possible under conditions similar to those under which the poles are cured. The transfer stage shall be determined based on the daily tests carried out on concrete cubes till the specified strength indicated above is reached. Thereafter the test on concrete shall be carried out as detailed in IS 1343 Code of practice for pre-stressed concrete. The manufacturer shall supply when required by the Engineer or his representative, results of compressive test conducted in accordance with IS: 456 Code of practice for plain and reinforced concrete on concrete cubes made from the concrete used for the poles. If the Engineer so desires, the manufacturer shall supply cubes for test purposes and such cubes shall be tested in accordance with IS: 456 Code of practice for plain and reinforced concrete. The de-tensioning shall be done by slowly releasing the wires, without imparting shock or sudden load to the poles. The rate of de-tensioning may be controlled by any suitable means either mechanical (Screw type) or hydraulic. The poles shall not be de-tensioned or released by cutting the pre-stressing wires using flames or bar croppers while the wires are still under tension.

7.8 Stacking should be done in such a manner that the broad side of the pole is vertical. Each tier in the stack should be supported on timber sleepers located at 0.15 times the overall length, measured from the end. The timber supports in the stack should be aligned in a vertical line.

7.9 Poles should be transported with their broad faces placed vertically and in such a manner that shocks are avoided. The supports should be so arranged that they are located approximately at a distance equal to 0.15 times the overall length, from the ends. The erection of the pole should be carried out in such a way that the erection loads are applied so as to cause

moment with respect to the major axis, i.e., the rope used for hoisting the pole should be parallel to the broader face of the pole.

**8.0 TEXTURING OF THE POLE: To make the poles surface non-slippery or antiskid the manufacturers shall add a textured or roughened finish to the pole surface during production by any one of the following methods.**

**a) Sandblasting or abrasive blasting to create a coarse surface.**

**b) Adding ridges, grooves or knurling patterns to the mold design to enhance grip.**

**9.0 EARTHING:**

9.1 Earthing shall be provided by having a separate length of 4 mm dia GI Wire embedded in concrete during manufacture and the ends of wire left projecting from the burrow end of the pole to a length of 100 mm at 215 mm from top of the pole and 150 mm below ground level. The arrangement for termination of the earth wire and fixing of the bolt and nut shall be as indicated in the enclosed drawings. The Wire used for embedding shall comply with the requirement of IS-2141/2000.

**10.0 TESTS:**

10.1 Transverse Strength Tests: Poles made from ordinary Portland cement shall be tested only on the completion of 28 days and poles made from rapid hardening cement, only on the completion of 14 days, after the day of manufacture.

10.2 The pole may be tested in either horizontal or vertical position. If tested in horizontal position, provisions shall be made to compensate for the overhanging weight of the pole. For this purpose, the overhanging portion of the pole may be supported on a movable trolley or similar device.

10.3 The pole shall be rigidly supported at the butt end for a distance equal to the depth of planting i.e., 1.7 meter for 9 meter poles.

10.4 Load shall be applied to at a point 600 mm from the top of the pole and shall be steadily and gradually increased to the design value of the transverse load for the first crack.

10.5 A Prestressed concrete pole shall be deemed not to have passed the test if visible cracks appear at a stage prior to the application of the design transverse load for the first crack.

10.6 The load shall then be reduced to a zero and increased gradually to a load equal to the first crack load plus 10% of the minimum ultimate transverse

load, and held up for 2 minutes. This procedure shall be repeated until the load reaches a value of 80% of the minimum ultimate transverse load and thereafter increased by 5% of the minimum ultimate transverse load until failure occurs. Each time the load is applied, it shall be held for 2 minutes. The load applied to Prestressed concrete pole at the point of failure shall be measured to the nearest five kilograms.

10.7 The pole shall be deemed not to have passed the test if the observed ultimate transverse load is less than the design ultimate transverse load.

10.8 Destruction Test: One pole out of a lot of 500 or less shall be subjected to destruction test to verify the steel and other aggregates used. No payment shall be made for the pole / poles which are subject to Destruction test.

## 11.0 MEASUREMENT OF COVER:

11.1 After completion of the transverse strength test, the sample pole shall be taken and checked for cover. The cover of the pole shall be measured at 3 points, one within 1.8 meters from the butt end of the pole, the second within 0.6 mtr. From the top and the third at an intermediate point and the mean value compared with the specified value.

11.2 The mean value of the measured cover should not differ by more than +/- 1 mm. from the specified cover. The individual values should not differ by more than +/- 3 mm. from the specified value. If these requirements are not met, the workmanship with reference to aligning of the end plates and per-stressing wires and assembly of moulds should be improved and inspection at production stage tightened suitably.

## 12.0 SCALE OF SAMPLING:

12.1 **Lot:** In any batch, all poles of the same class and same dimensions shall be grouped together to constitute a lot.

12.2 **Sub-Lot:** If the number of poles in a lot exceeds 500, the lot shall be divided into a suitable number of sub-lots such that the number of poles in any sub-lot shall not exceed 500. The acceptance or otherwise of a sub-lot shall be determined on the basis of the performance of samples selected from it.

12.3 The number of poles to be selected from a lot or a sub-lot shall depend upon its size and shall be in accordance with Col. 1 and 2 of the following table

| No. of poles in the Lot | Sample Size | Dimensional Requirement Acceptance Number | Transverse Strength Test | Transverse Strength Ultimate |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| Up to 100 | 10 | 1 | 2 | 1 |
| 101 to 200 | 15 | 1 | 3 | 1 |
| 201 to 300 | 20 | 2 | 4 | 1 |
| 301 to 500 | 30 | 3 | 5 | 2 |

The poles shall be selected at random. In order to ensure randomness, all the poles in the lot of the sub-lot may be arranged in a serial order and starting from any random pole, every 7th pole may be included in the sample `r' being the integral part of N/n where `N' is the size of the sub-lot and `n' is the sample size.

**13. NUMBER OF TESTS :**

13.1 All the poles as selected in accordance with Clause 11.3 shall be checked for overall length, cross section and uprightness. The tolerance shall be +/- 15 mm. on overall length, +/- 3 mm. on cross sectional dimensions and 0.5 % on uprightness.

13.2 The number of poles to be tested for transverse strength test shall be in accordance with column-4 of the above Table. These poles may be selected from those already tested.

**14. CRITERIA FOR CONFORMITY:**

14.1 A lot or sub-lot shall be considered as conforming to this specification if the conditions under 11.1 and 11.2 are satisfied.

14.2 The number of poles, which do not satisfy the requirements of overall length, cross section and uprightness, shall not exceed the corresponding number given in column 3 of Table. If the number of such poles exceeds the corresponding number, all poles in the lot or Sub-lot shall be tested for these requirements, and those not satisfying the requirements shall be rejected.

14.3 All the poles tested for transverse strength test shall satisfy the requirements of the test. If one or more poles fail, twice the number of poles originally tested shall be selected from those already selected and subjected to the test. If there is no failure among these poles, the lot or the sub-lot shall be considered to have satisfied the requirements of this test.

**NOTE:** No payment will be made for the tested pole, which fails or poles, which are tested to destruction.

15. **MARKING**:

The pole shall be clearly engraved and indelibly marked with the following particulars during manufacture but before testing at a position so as to be easily read after erection in position.

a. Month and year of manufacture
b. Transverse strength of pole in Kg
c. Makers Sl.No. And mark

d. Line indicating depth of planting at 1.7 Mtr.
e. Engraved letters indicating BESCOM.
f. P.O. No. / Date
g. Any other details as specified.

**General Manager (Ele)**
**Quality, Standards & Safety**